US006907498B2

(12) **United States Patent**
Kitamura et al.

(10) **Patent No.: US 6,907,498 B2**
(45) **Date of Patent: *Jun. 14, 2005**

(54) **COMPUTER SYSTEM AND A METHOD OF ASSIGNING A STORAGE DEVICE TO A COMPUTER**

(75) Inventors: **Manabu Kitamura**, Yokohama (JP); **Kenji Yamagami**, Los Gatos, CA (US); **Tetsuya Murakami**, Odawara (JP)

(73) Assignee: **Hitachi, Ltd.**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 269 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **10/095,582**

(22) Filed: **Mar. 13, 2002**

(65) **Prior Publication Data**

US 2003/0009528 A1 Jul. 11, 2003

Related U.S. Application Data

(62) Division of application No. 09/642,617, filed on Aug. 22, 2000.

(30) **Foreign Application Priority Data**

Aug. 27, 1999 (JP) 11-241024

(51) Int. Cl.[7] G06F 12/00

(52) U.S. Cl. 711/112; 711/152

(58) Field of Search 711/114, 152, 711/153, 156, 707/200; 709/212

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,310,883	A	1/1982	Sakaguchi	707/205
4,607,346	A *	8/1986	Hill	711/170
4,771,375	A	9/1988	Beglin et al.	711/111
5,018,060	A	5/1991	Gelb et al.	707/205
5,619,690	A *	4/1997	Matsumoto et al.	707/200

(Continued)

FOREIGN PATENT DOCUMENTS

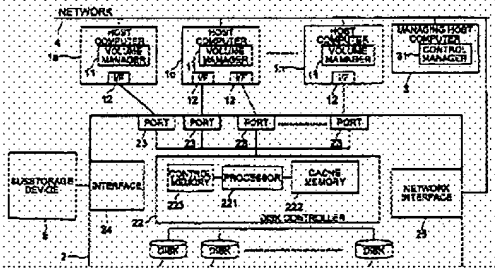
JP	10-333839	12/1998

Primary Examiner—Nasser Moazzami
(74) *Attorney, Agent, or Firm*—Mattingly, Stanger, Malur & Brundidge, P.C.

(57) **ABSTRACT**

A computer system which has a plurality of computers and a storage device subsystem connected to the plurality of computers. The storage device subsystem has a plurality of storage devices and a plurality of interfaces, through which the subsystem is connected to the computers. One of the plurality of computers has a management means for holding therein data indicative of the storage devices and a connection relationship between the computers and storage device subsystem. Each computer, when sending a new device, informs the management means of its capacity and type. The management means receives its notification and selects one of the storage devices which satisfies the request. And the management means instructs the storage device subsystem to set predetermined data in such a manner that the computer can access the selected device. The management means also returns predetermined data to the computer as a device assignment requester, the assignment requester computer modifies setting thereof to allow the computer in question can use the assigned device.

18 Claims, 23 Drawing Sheets



US006883064B2

(12) **United States Patent**
Yoshida et al.

(10) Patent No.: **US 6,883,064 B2**
(45) Date of Patent: **Apr. 19, 2005**

(54) **DISK ARRAY CONTROLLER COMPRISING A PLURALITY OF DISK ARRAY CONTROLLING UNITS**

(75) Inventors: **Akira Yoshida**, Hadano (JP); **Shuji Nakamura**, Odawara (JP)

(73) Assignee: **Hitachi, Ltd.**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 101 days.

(21) Appl. No.: **10/076,456**

(22) Filed: **Feb. 19, 2002**

(65) **Prior Publication Data**

US 2003/0084237 A1 May 1, 2003

(30) **Foreign Application Priority Data**

Oct. 30, 2001 (JP) 2001-331858

(51) Int. Cl.[7] G06F 13/00

(52) U.S. Cl. 711/114; 711/111; 711/112; 711/113

(58) Field of Search 711/111-114; 714/6

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,537,428 A * 8/1996 Iasiz 711/114
2002/0054587 A1 * 5/2002 Fan 370/230
2002/0188804 A1 * 12/2002 Raivio et al. 711/216

FOREIGN PATENT DOCUMENTS

EP 1132805 A2 * 9/2001 ..... G06F/3/06
JP 11296313 A * 10/1999 ..... G06F/3/06

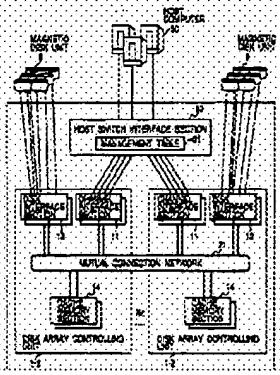
* cited by examiner

Primary Examiner—Mano Padmanabhan
Assistant Examiner—John M Ross
(74) *Attorney, Agent, or Firm*—Mattingly, Stanger & Malur, P.C.

(57) **ABSTRACT**

"Disk array system is presented wherein the plurality of disk array controlling units operate as the sole disk array controller so as to restrain the performance of the cache memory sections of the respective disk array controlling units from deteriorating owing to their physical packaging locations and to maximize the performance thereof in proportion to the number of the controlling units in use. Disk array controller is provided, which controller comprises a host switch interface section, the plurality of respective disk array controlling units provided with a channel interface section, a disc interface section and a cache memory section and a mutual connection network in connection with the channel interface sections, the disk interface sections and the cache memory sections of the respective disk array controlling units. Access performance to the cache memory sections that are dispersedly disposed between the respective disk array controlling units improves so as to enhance the performance of the disk array controller in proportion to the number of the disk array controlling units in use."

12 Claims, 8 Drawing Sheets



US006725330B1

(12) **United States Patent**
Wong et al.

(10) **Patent No.: US 6,725,330 B1**
(45) **Date of Patent: Apr. 20, 2004**

(54) **ADAPTABLE CACHE FOR DISC DRIVE**

(75) Inventors: **Patrick Tat Heng Wong**, Singapore (SG); **Beng Wee Quak**, Singapore (SG); **YongPeng Ching**, Singapore (SG); **Wesley Wing Hung Chan**, Singapore (SG); **WeiLeen Ng**, Singapore (SG)

(73) Assignee: **Seagate Technology LLC**, Scotts Valley, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 683 days.

(21) Appl. No.: **09/649,106**

(22) Filed: **Aug. 25, 2000**

Related U.S. Application Data

(60) Provisional application No. 60/151,203, filed on Aug. 27, 1999.

(51) Int. Cl.[7] **G06F 12/00**

(52) U.S. Cl. 711/113; 711/120; 713/2

(58) Field of Search 711/113, 129, 711/123, 173; 713/2, 1

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,766,149	A *	8/1988	Konopik et al.	710/47
4,951,951	A	9/1990	Ryan	
5,125,088	A *	7/1992	Auslander et al.	711/1
5,276,840	A	1/1994	Yu	
5,455,945	A	10/1995	Hyatt	
5,526,506	A	6/1996	Hyatt	
5,537,573	A	7/1996	Wise et al.	
5,606,517	A	2/1997	Mecca, Jr. et al.	
5,612,999	A	2/1997	Hyatt	
5,805,581	A	2/1997	Smith et al.	
5,666,368	A *	9/1997	Wu	711/3
5,754,888	A	5/1998	Yang et al.	
5,784,707	A	7/1998	Chin et al.	
5,787,472	A	7/1998	Dan et al.	
5,829,025	A	10/1998	Blakley	
5,860,212	A	3/1999	Sokolow et al.	
5,923,885	A	7/1999	Genduso et al.	
5,924,116	A	7/1999	Aggarwal et al.	
6,249,864	B1 *	6/2001	Ito	713/2

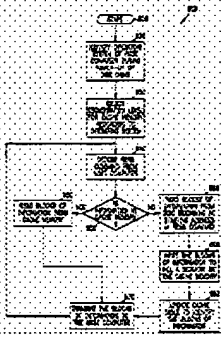
* cited by examiner

Primary Examiner—Matthew Kim
Assistant Examiner—Matthew D. Anderson
(74) *Attorney, Agent, or Firm*—David K. Lucente; Derek J. Berger

(57) **ABSTRACT**

According to one embodiment of the present invention a disc controller in a disc drive includes a cache memory and a control circuit. The control circuit is configured to identify an operating system of a host computer coupled to the disc drive, select a segmentation level for the cache memory based on the identified operating system, and store information in the cache memory according to the segmentation level. According to another embodiment of the present invention a cache memory in a disc drive is operated by identifying an operating system of a host computer coupled to the disc drive, selecting a segmentation level for the cache memory based on the identified operating system, and storing information in the cache memory according to the segmentation level. The operating system is identified by reading a partition type from a master boot record stored in a disc in the disc drive.

17 Claims, 4 Drawing Sheets



US006647461B2

(12) **United States Patent**
Fujimoto et al.

(10) Patent No.: US 6,647,461 B2
(45) Date of Patent: Nov. 11, 2003

(54) **DISK ARRAY CONTROLLER, ITS DISK ARRAY CONTROL UNIT, AND INCREASE METHOD OF THE UNIT**

(75) Inventors: Kazuhisa Fujimoto, Kokubunji (JP); Hiroki Kanai, Higashiyamato (JP); Akira Fujibayashi, Kokubunji (JP); Wataru Sakurai, Odawara (JP)

(73) Assignee: Hitachi, Ltd., Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: 10/335,899

(22) Filed: Jan. 3, 2003

(65) **Prior Publication Data**

US 2003/0115355 A1 Jun. 12, 2003

Related U.S. Application Data

(63) Continuation of application No. 10/234,471, filed on Sep. 5, 2002, now Pat. No. 6,519,680, which is a continuation of application No. 09/585,595, filed on Sep. 15, 2000, now Pat. No. 6,477,619.

(30) **Foreign Application Priority Data**

Mar. 10, 2000 (JP) 2000-070669

(51) Int. Cl.[7] G06F 12/02

(52) U.S. Cl. 711/114; 711/113; 711/148; 710/313; 710/316

(58) Field of Search 711/113, 114, 711/148; 710/314, 316

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,603,025	A	2/1997	Bauman et al.	710/317
5,680,640	A	10/1997	Ofek et al.	709/100
5,841,775	A	11/1998	Hung	340/825.29
5,909,455	A	6/1999	Bauman	711/120
6,006,296	A	12/1999	Gelb et al.	710/100
6,065,333	A *	7/2000	DeKoning et al.	714/7
6,092,155	A	7/2000	Olnowich	709/200
6,256,749	B1 *	7/2001	Kakuta et al.	714/6
6,385,681	B1 *	5/2002	Fujimoto et al.	710/316
6,425,049	B1 *	7/2002	Yamamoto et al.	711/112
6,477,619	B1	11/2002	Fujimoto	
2001/0021325	A1 *	5/2001	Fujimoto et al.	711/114
2002/0065528	A1 *	7/2002	Matsumoto et al.	711/114

FOREIGN PATENT DOCUMENTS

JP	1-96693	3/1999

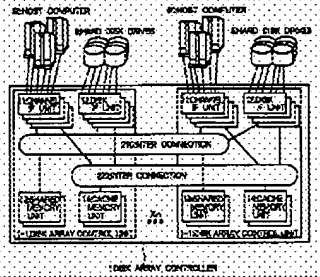
* cited by examiner

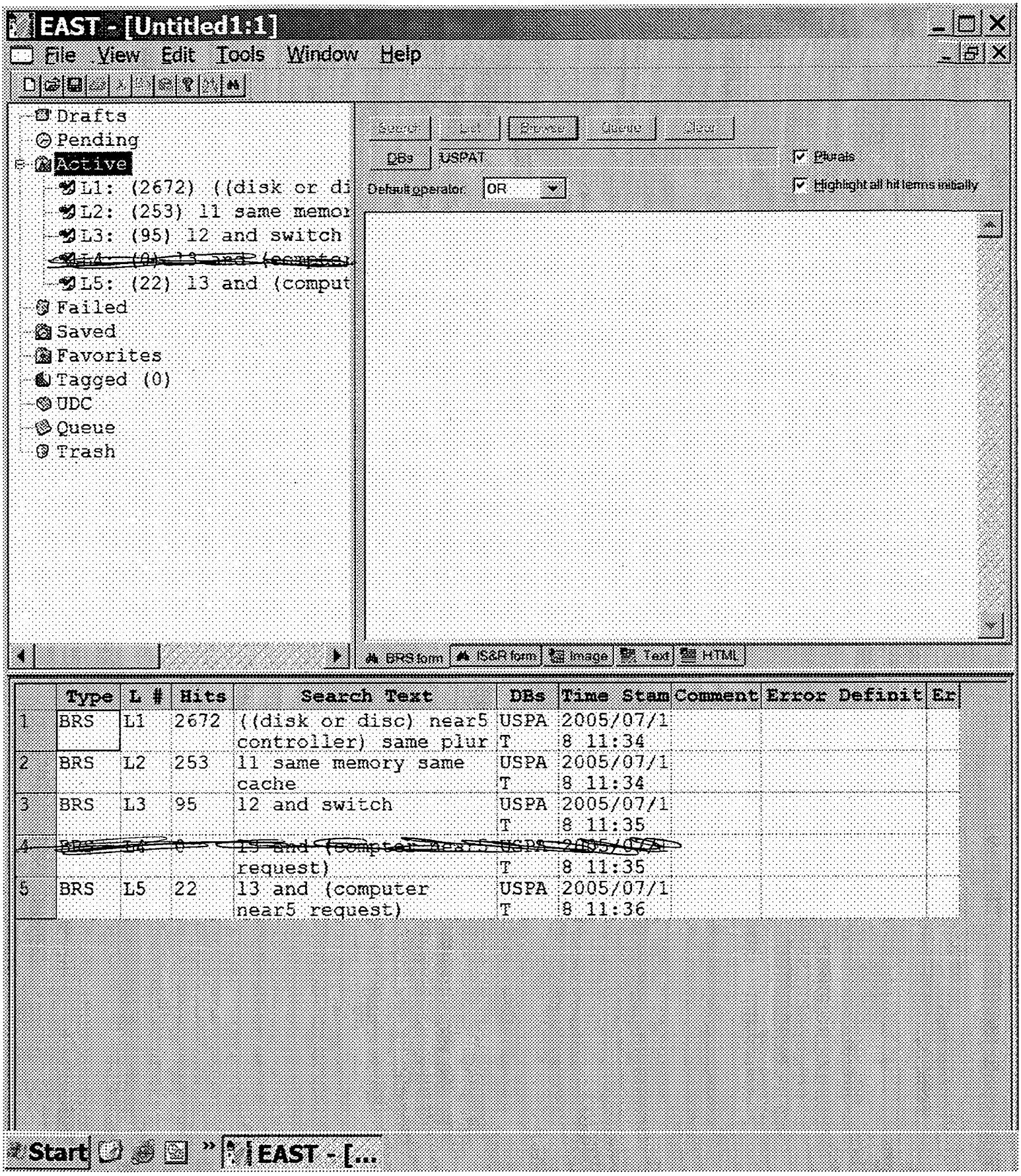
Primary Examiner—Hiep T. Nguyen
(74) *Attorney, Agent, or Firm*—Antonelli, Terry, Stout & Kraus, LLP

(57) **ABSTRACT**

A disk array controller is made up of multiple disk array control units for implementing the data read-write operation and each having channel IF units, disk IF units, cache memory units and shared memory units. The disk array controller further includes inter connections for interconnecting the shared memory units and interconnecting the cache memory units across the border of disk array control units. Thereby alleviating the deterioration of performance due to the data transfer between the disk array control units, when the multiple disk array control units are to be operated as a single disk array controller.

8 Claims, 21 Drawing Sheets

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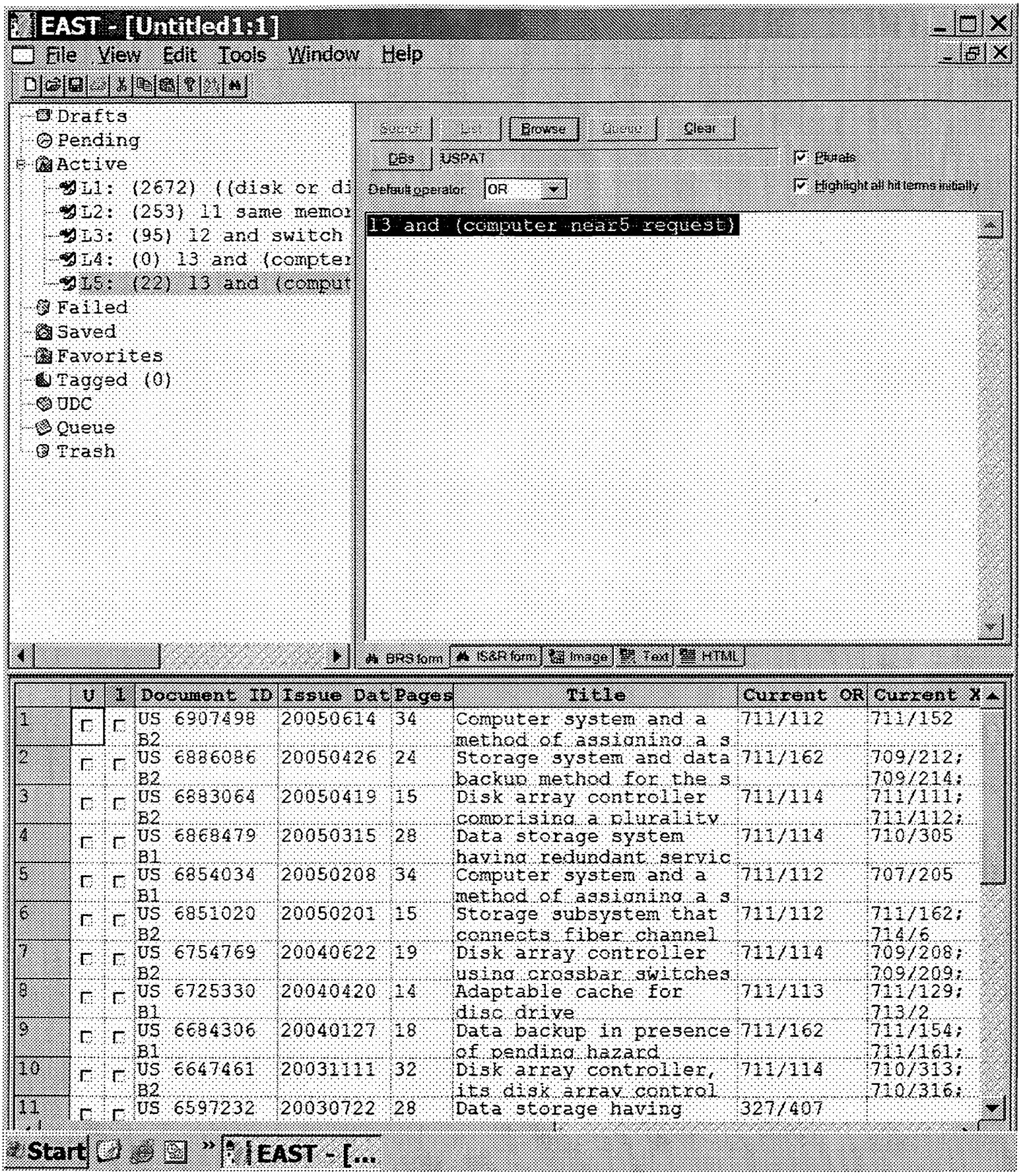
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1 US 6907498 B2 20050614 34 Computer system and a method of assigning a s 711/112 711/152
2 US 6886086 B2 20050426 24 Storage system and data backup method for the s 711/162 709/212; 709/214;
3 US 6883064 B2 20050419 15 Disk array controller comprising a plurality 711/114 711/111; 711/112;
4 US 6868479 B1 20050315 28 Data storage system having redundant servic 711/114 710/305
5 US 6854034 B1 20050208 34 Computer system and a method of assigning a s 711/112 707/205
6 US 6851020 B2 20050201 15 Storage subsystem that connects fiber channel 711/112 711/162; 714/6
7 US 6754769 B2 20040622 19 Disk array controller using crossbar switches 711/114 709/208; 709/209;
8 US 6725330 B1 20040420 14 Adaptable cache for disc drive 711/113 711/129; 713/2
9 US 6684306 B1 20040127 18 Data backup in presence of pending hazard 711/162 711/154; 711/161;
10 US 6647461 B2 20031111 32 Disk array controller, its disk array control 711/114 710/313; 710/316;
11 US 6597232 20030722 28 Data storage having 327/407
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